

IN THE CLAIMS:

No claims are amended herein. Please note that all claims currently pending and under consideration in the referenced application are shown below. This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (previously twice amended) A residue-free contact opening in a dielectric layer for a semiconductor device extending from an upper surface of said dielectric layer to a metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;

forming said dielectric layer over said semiconductor substrate and said metal-containing

conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad and including a residue residing within said at least one opening;

applying nitric acid within said at least one opening; and

subsequently applying a phosphoric acid-containing solution within said at least one opening.

2. (previously twice amended) A contact within a residue-free opening in a dielectric layer for a semiconductor device extending from an upper surface of said dielectric layer to a metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;

forming said dielectric layer over said semiconductor substrate and said metal-containing

conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad, and wherein a residue resides within said at least one opening;

applying a nitric acid within said at least one opening;
subsequently applying a phosphoric acid-containing solution within said at least one opening;
and
disposing conductive material within said at least one opening.

3. (previously twice amended) A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device comprising a semiconductor substrate having a metal-containing conductive pad under said dielectric layer and said barrier layer, said residue-free contact formed by a method comprising:
providing a semiconductor substrate having a metal-containing conductive pad;
forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
forming said dielectric layer over said barrier layer;
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;
forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions;
applying nitric acid within said first and second via portions to remove said metal polymer residue; and
subsequently applying a phosphoric acid-containing solution within said first via portion to remove said oxide polymer residue.

4. (previously twice amended) A residue-free contact opening in a dielectric layer and a barrier layer above a metal-containing conductive pad for a semiconductor device, said residue-free contact formed by a method comprising:
providing a semiconductor substrate having a metal-containing conductive pad;

forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
forming said dielectric layer over said barrier layer;
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;
applying a phosphoric acid-containing solution within said first via portion to remove said oxide polymer residue;
forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions; and
applying a nitric acid-containing solution within said first and second via portions to remove said metal polymer residue.

5. (previously twice amended) A residue-free contact opening in a dielectric layer over a metal-containing conductive pad for a semiconductor device extending from an upper surface of said dielectric layer to said metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:
providing a semiconductor substrate having a metal-containing conductive pad;
forming said dielectric layer over said semiconductor substrate and said metal-containing conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad, and wherein a residue resides within said at least one opening;
applying nitric acid within said at least one opening; and
subsequently applying a phosphoric acid solution including a fluorine-containing component within said at least one opening.

6. (previously twice amended) A contact within a residue-free opening in a dielectric layer for a semiconductor device extending from an upper surface of said dielectric layer to a metal-containing conductive pad, having substantially parallel sidewalls and formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;
forming said dielectric layer over said semiconductor substrate and said metal-containing conductive pad with at least one opening extending from an upper surface of said dielectric layer to said metal-containing conductive pad, and wherein a residue resides within said at least one opening;
applying a nitric acid within said at least one opening;
subsequently applying a phosphoric acid solution, including a fluorine-containing component, within said at least one opening; and
disposing conductive material within said at least one opening.

7. (Cancelled)

8. (previously twice amended) A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device including a semiconductor substrate having a metal-containing conductive pad under said dielectric layer and said barrier layer, said residue-free contact formed by a method comprising:

providing a semiconductor substrate having a metal-containing conductive pad;
forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
forming said dielectric layer over said barrier layer;
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions;
applying nitric acid within said first and second via portions to remove said metal polymer residue; and
subsequently applying a phosphoric acid solution including a fluorine-containing component within said first via portion to remove said oxide polymer residue.

9. (previously twice amended) A residue-free contact opening in a dielectric layer and a barrier layer above a metal-containing conductive pad for a semiconductor device, said residue-free contact formed by a method comprising:
providing a semiconductor substrate having a metal-containing conductive pad;
forming said barrier layer over said semiconductor substrate and said metal-containing conductive pad;
forming said dielectric layer over said barrier layer;
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;
applying a solution including a fluorine-containing component within said first via portion to remove said oxide polymer residue;
forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions; and
applying nitric acid within said first and second via portions to remove said metal polymer residue.